

5.0 ANALYTICAL DATA GAPS

5.1 Identification of Analytical Data Gaps

The focus of this EE/CA is analysis of alternatives to remediate the two heap leach pads and the PSP. Subsequent to submittal of the initial draft of the document, Harding ESE was requested to provide a cursory analysis of backfilling the pit and to develop costs for this alternative. The addition of pit backfilling as an alternative created data gaps in available information. Additional characterization of soil, surface water and groundwater was needed, as was additional characterization of the heap leach pads. Sampling to fill critical data gaps identified during discussions with the NPS and EPA was conducted while Harding ESE personnel were on site following construction of the Interim Measures and start-up of the re-circulation system. Other data gaps were filled by analyzing data collected during the sampling event, provided by the NPS, or were not applicable at this point in the mine reclamation process. The data gaps were:

1. Site specific background soil, surface water and groundwater analysis;
2. Geotechnical data from heap leach pads;
3. Evaluation of pit backfill;
4. Analysis of solution from pads and PSP including nitrate, nitrite and ammonia;
5. Calculating a nitrogen balance for the heap leach pads and PSP;
6. Determine depth of water in open pit;
7. Groundwater elevations, gradient, and quality;
8. Geochemical data (contamination) directly beneath the heap leach pads and pregnant solution pond;
9. Delineation of desert tortoise habitat and population estimation;
10. Identification of additional sensitive wildlife and vegetative species and their habitats in the Preserve;
11. Delineation of burro habitat and population estimation;
12. Cause of livestock mortalities; and
13. Archaeological survey.

5.2 Response to Analytical Data Gaps

1. Site specific background soil, surface water and groundwater analyses.

Further characterization of soil, surface water and groundwater was needed to define pre-mine conditions and to analyze on-site closure alternatives.

Background Soil Analysis and Discussion:

Six five-point composite samples were collected from sites up gradient and down gradient of the operation (Fig. 3). Laboratory analyses of samples collected from sites selected to represent background soil conditions are presented in Table 5.1. The samples were collected to corroborate background concentrations of metals as presented by Bradford, et. al. for San Bernardino County.

Background metals in soil levels are typically developed to contain a range of values for a particular geographic area. Certain factors can influence the “typical” ranges. For example, an ore body near the surface (whether developed as a mine or not) can increase local levels of certain metals to above what is typical for the area. Similarly, certain metals found in one area may not be present in others. Background concentrations at the Morning Star Mine identified through the sampling conducted in July 2002 reveal that:

- Three of the six samples collected and analyzed for lead were above the background concentrations for San Bernadino County as presented by Bradford, et. al.. The others were within ranges. All were below regulatory limits.
- Three of the six samples had copper within the established ranges and three were below. All of the six were below regulatory standards.
- All other constituents were lower than the established background ranges or in non-detectable concentrations.

Surface Water:

With the exception of the pit and PSP, there is no surface water at the site. Previous samples were collected from a leak at Pad No. 2, the sump located on that pad, the drain pipe for Pad No. 1, and the PSP. The leak has since dried, water from the sump on Pad No. 2 cannot be considered surface water, and the drain from Pad No. 1 flows directly into the PSP. All areas have been previously characterized. Two surface water samples were collected (Table 3.1), one from the pit to continue the data compilation from previous sampling events, and one from the PSP. The PSP

sample was collected to determine the effects, if any, that the Interim Measures re-circulation system (Section 9) was having on mixing leach pad and PSP solutions.

Groundwater:

Monitor Wells - No water was detected in any of the monitoring wells.

Lower Well – One sample was collected from the lower well (Table 5.2); however, there was no pump installed and it was not purged.

Upper Well - The pump in the upper well was operational. Utilizing a generator, the well was purged (3 well volumes) and a sample collected (Table 5.2). In addition, a multi-step draw-down test was conducted on this well (see Section 9.4.3).

2. Geotechnical data from heap leach pads.

Geotechnical data from the heap leach pads will not be generated unless capping in place is selected as the preferred alternative.

3. Evaluation of pit backfill.

The closure alternative of backfilling the pit was identified but not brought forward for evaluation in the draft streamlined EE/CA because it was beyond the initial scope of work. Harding ESE has subsequently been directed to evaluate and develop a cost estimate for (1) backfilling the pit with waste rock; and (2) backfilling the pit with heap leach pad material as part of completion of the document. In both scenarios, the pit highwall would be left. The option of backfilling the pit to a free-draining elevation prior to disposal of pad or waste material is evaluated, as is the need to line the pit floor prior to any disposal action. Treatment of pad material in place (prior to removal to the pit) as well as during placement in the pit will be evaluated. A more comprehensive characterization of heap leach pad and waste rock material was needed to make this analysis.

Three five-point composite samples were collected of waste rock and four five-point composite samples were collected from each heap leach pad (two from each pad). Samples of heap leach pad material and waste rock were analyzed to determine levels of acidity and neutralization potential present (Table 5.3). The BLM policy for acid rock drainage (ARD Policy) as authorized by 43 CFR 3802 and 3809 was used as a frame of reference for evaluation of static predictive laboratory analyses (US BLM, 1996). The BLM Policy guidance is that where the neutralization potential values are three times larger than the acid producing values and the net neutralizing potential is greater than +20, the sample would not be acid generating. While these values are

used as a screening mechanism, they provide a context for evaluation of the acid generating potential for pad material and waste rock at MSM.

The very low percentage of hot water extractable sulfur and low sulfur residual, indicates that most of the sulfur is likely present as sulfides. As shown in Table 5.3, all of the material tested had Neutralization Potential Ratios (NPRs) greater than 6:1 based on either the total sulfur or sulfur as sulfide acid potential (AP). As discussed in the previous paragraph, a NPR greater than 3:1 is indicative of a low acid leachate producing potential.

The static test (modified Sobek) used to evaluate the AP and NP only evaluates the maximum potential for any material to produced acid leachate. It does not take into account site-specific conditions such as climate, nor does it account for the kinetics of the acid producing process. The results of these analyses and the lack of moisture at the site confirmed the conclusions from the previous investigation; the waste rock is not likely to produce an acidic leachate.

4. Analysis of solution from pads and PSP for nitrate, nitrite and ammonia.

Further analysis of the potential to provide bioremediation of cyanide, metals and nitrate in the heap leach pads and PSP required a better understanding of the nitrate balance in these facilities. Treatment of the heap leach pads and process solution is being considered as part of all alternatives except the no action alternative. Solution samples from the PSP, Pad No. 1 drainage and the sump on Pad No. 2 were analyzed for nitrate plus nitrite as N, ammonia and Total Kjeldahl nitrogen (Table 5.4).

5. Calculating a nitrogen balance of heap leach pads and PSP.

Establishing the nitrogen balance of the heap leach pads and the PSP will be important for cost analysis of all closure alternatives except the no action alternative. Each alternative will require water management and potential treatment as a component of the remedial action. All nitrate must be biochemically reduced prior to reduction of other metal species. The biochemical solution to be used to treat the solution inventory will reflect the unique characteristics of the process solution and heap leach pad material at the site. A nitrogen balance of these site components is required to design the solution. One additional analytical test was conducted to obtain this information; an analysis of ammonia, KCL extract method, from solid samples collected at depth from the heap materials. This analysis will help determine the nitrogen balance for these site features (Table 5.4).

6. *Determine depth of water in open pit.*

This information was needed for evaluation of the pit backfill alternative. The topographic elevation of water in the pit was surveyed with a Global Positioning Station (GPS). The elevation is compared to groundwater elevations in Table 5.2. Because of the danger of falling rock from the pit high-wall, no water depth measurements were taken. Pit water depth is estimated at 20-25 feet deep.

7. *Groundwater elevations, gradient, and quality.*

This information was needed for evaluation of the pit backfill alternative, assist to determine the volume of groundwater available to rinse the pads and to characterize general conditions at the site. Groundwater elevation and gradient was established by examining the water level in both fresh water supply wells and the pit water. See paragraph No. 1 above for the discussion of ground water quality sampling. A discussion of the pump test and results is presented in Section 9.4.2. The pump test enabled conclusions to be drawn relative to the depth of water in the pit and the elevation of groundwater in the upper groundwater well.

8. *Geochemical data (contamination) directly beneath the heap leach pads and pregnant solution pond.*

If the Preferred Alternative selected is removal of the pads and PSP, characterization of the disturbance footprints of these site components would be addressed during post-removal sampling.

9. *Delineation of desert tortoise habitat and population estimation.*

The mine site is within desert tortoise habitat (NPS, 2002). Close coordination will be maintained with NPS biologists prior to the startup of any fieldwork. Site orientation will include a presentation by the park biologist regarding identification and avoidance of potential hazards to tortoise during construction activities. Coordination and orientation were conducted early on in the Interim Measures Action.

Responses to other data gaps, filled by information provided by NPS biologists, have been incorporated into this EE/CA. They are:

10. Identification of additional sensitive wildlife and vegetative species and their habitats in the Preserve.

Existing information provided by NPS biologists has been utilized to identify the sensitive species within the Preserve.

11. Delineation of burro habitat and population estimate.

Long term management plans for permitting domestic livestock grazing and the impact of feral burros on fragile desert ecosystems are discussed in the Mojave Management Plan (MNP, 2002). This information has been incorporated into the EE/CA.

12. Livestock mortalities.

Livestock mortalities have occurred immediately adjacent to the heap leach pads. The position of the NPS is that the mine does not pose a threat to human health; the potential ecological threat posed by the mine is directly related to the presence of contaminated water captured by the pad and PSP liners. Once this attractant has been removed, the ecological risk will be minimized.

13. Archaeological survey.

NPS personnel will determine whether an archaeological survey of the mine site is required prior to initiation of any of the closure alternatives.

5.3 Other Gaps

1. Clarification of regulatory and administrative questions.

NPS and LRWQCB personnel will negotiate abatement of conditions contained in the Administrative Orders issued to Vanderbilt Gold Corporation and the National Park Service.

2. Clarification of questions related to the 4EM proposal.

The NPS has requested additional information from the 4EM Company. In the event that the 4EM proposal is selected as the Preferred Alternative, the NPS will request supplementary explanation and financial data from the company.